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Sensitivity of Aerosol Indirect Forcing to Aerosol Characteristics and Global Concentration

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The contribution of aerosols to climate change results from two effects: clear-sky (direct) and cloudy-sky (indirect) forcing. In contrast to the direct effect which is more significant over land, the indirect effect is much more pronounced over the ocean where clouds are relatively optically thin. We have been using a coupled climate/chemistry model with cloud nucleation processes parameterized in terms of local aerosol characteristics and updraft velocity to estimate the aerosol indirect forcing. The simulated cloud drop effective radii have been compared with those retrieved from satellite data to validate the accuracy of our cloud drop parameterizations. Our previous studies have shown that the indirect forcing is highly sensitive to the natural aerosol abundance. In this paper, we investigate not only the sensitivity of the indirect forcing to the uncertainty in biogenic ocean DMS emissions but also the sensitivity to the other possible sources of marine background particles such as sea salt and organic aerosols. Sensitivity studies have also been performed to quantify the uncertainty attributed to various chemical and physical nature of aerosols. The absorption of radiation by black carbon associated with cloud and its impact on the indirect forcing will also be addressed.

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